# MapReduce Join Optimization

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## 1

For this prototype 3-way join we are using the Mondial dataset. We are performing the join *country* $\bowtie$ *ismember* $\bowtie$ *organization*. The query corresponds to the SQL query:

```
SELECT
  code, abbreviation, c.name AS cname, NULL, o.name AS oname
  FROM country c, ismember m, organization o
  WHERE c.code=m.country AND m.organization=o.abbreviation;
```

The schema after projectection performed in the mapper is:

```
country(code, name)
ismember(country, organization)
organization(abbreviation, name)
```

There are two sets of join keys, which in this case are both of size 1. The join key between country and ismember shall be referred to as A, and the join key between ismember and organization shall be referred to as B. Each join key has a key share, which represents the number of buckets the keys are hashed into. In this case both keys have a share of 5. There are 25 reducers which represent a 5x5 grid. We can visualize this as follows:

|  |  | h(B) |  |  |  |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| h(A) |  | X |  |  |  |
|  |  |  |  |  |  |

A row from the relation ismember has both join keys. In this case we know exactly which reducer to send the result to. In this case of the other relations, we must do a broadcast. A row from country will have to be multicast to all reducers in the associated row of the reducer matrix. Suppose we have a row from country, ”F France Column3 Column4”, and suppose that hash(F) = 3. We will construct 5 result key/value pairs which correspond to the 5 buckets of B, or columns of the matrix.

|  |  |  |  |  |  |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| h(A) | X | X | X | X | X |
|  |  |  |  |  |  |

Each key from the mapper is tagged with the relation tag. The relation tag for the middle relation is capitalized. This is to enforce an ordering on the keys as they are presented to the reducer. The reducer will process keys in the order: ismember, country, organization. In the reducer a hash join is performed. Each key from the middle relation, ismember, is inserted into the hash table with the key from country. Each row from country then joins with rows from ismember and inserts the result into the hashtable using the key from organization. Each row from organization then completes the join and outputs the result.